AD-A156 471 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS BAXTER LAKE CENTER DI..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV JUL 78 1/1

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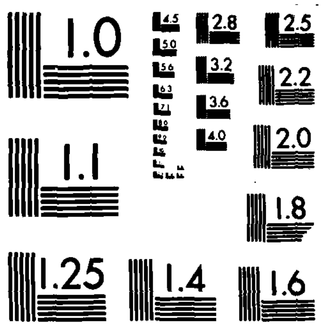

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PISCATAQUA RIVER BASIN
ROCHESTER, NEW HAMPSHIRE

BAXTER LAKE CENTER DIKE
NH 00393

STATE NO 204.10

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JULY 1978

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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Piscataqua River Basin
Rochester New Hampshire
Rickers Brook

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is 10 ft. high and 240 ft. long. It is an earthen embankment with an 18 inch core wall. THe dike is in good condition although there are a few minor concerns that need attention. The dike has no outlet.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

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Honorable Meldrim Thomson, Jr.
Governor of the State of
New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Thomson:

I am forwarding to you a copy of the Baxter Lake Center Dike Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, Baxter Lake Recreation Area, Inc., 22 Concord Street, Nashua, New Hampshire 03060.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely yours,

John P. Chandler

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

BAXTER LAKE CENTER DIKE

NH 00393

PISCATAQUA RIVER BASIN
ROCHESTER, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

This Phase I Inspection Report on Baxter Lake Center Dike Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Charles G. Tiersch

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

Fred J. Ravens Jr.

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

Saul Cooper

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	NH00393
Name of Dam:	Baxter Lake Center Dike
Town:	Rochester
County and State:	Strafford County, New Hampshire
Stream:	Rickers Brook
Date of Inspection:	14 June 1978

BRIEF ASSESSMENT

Baxter Lake Center Dike is 10 feet high, 12 feet wide at the crest, and 240 feet long. It is an earthen embankment with an 18-inch core wall. The upstream and downstream faces have 3H:1V side slopes. The upstream slope is faced with riprap. An access road has been built along the crest of the dike. Baxter Lake is impounded by the Main Dam, Center, Westerly, and Easterly Dikes. The lake is 1 mile long, has a surface of over 300 acres, and is used for recreation. Maximum storage is 1,720 acre-feet.

Center Dike is in good condition. Minor concerns to its integrity include a minor seepage at the downstream toe near the east abutment, brush growing on the slopes, and potential erosion of the unpaved roadway.

The dike has no outlet. The test flood would not overtop the dike; however, other dikes in the impounding system would be overtopped. The test flood would rise to within 1.1 feet of the lowest point on the crest.

The owner, Baxter Lake Recreation Area, Inc., should, within four years, retain the services of a registered professional engineer and implement the results of his evaluation of the following recommendation: design remedial measures for the seepage at the downstream toe of the dike near the east abutment. Within one year, the following operation and maintenance measures should be implemented: monitor the seepage weekly, clear brush and trees on the faces and along the access road, and establish a surveillance and warning program to be exercised during floods.

Warren A. Guinan

Warren A. Guinan
Project Manager
N.H. P.E. No. 2339

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

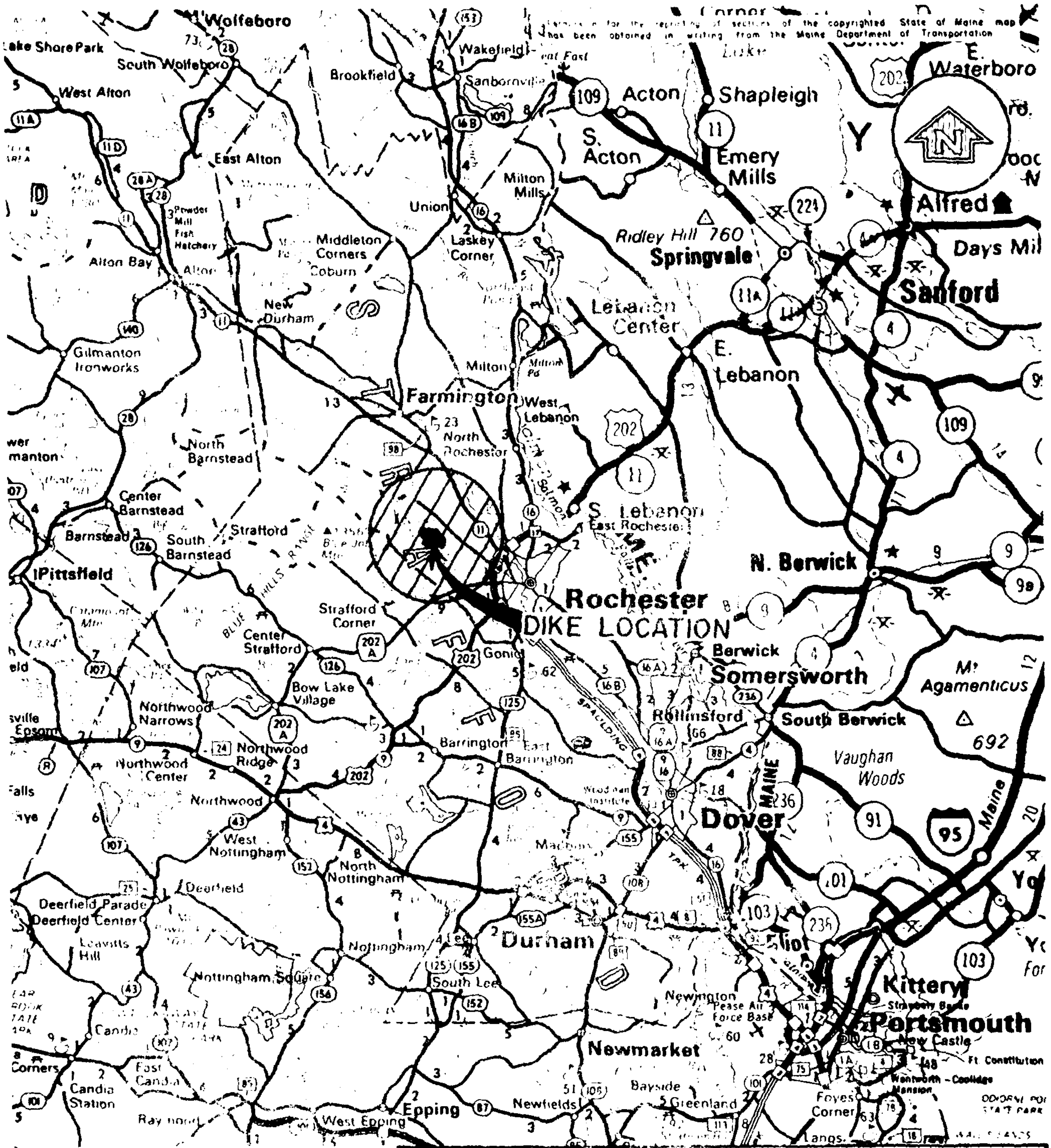
In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

CONTENTS

Figure 1 - Overview of the upstream face of the Center Dike.



Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BAXTER LAKE CENTER DIKE LOCATION MAP

BAXTER LAKE NEW HAMPSHIRE

SCALE 1" = 5 Mi

DATE: JULY 1978

SCALE IN MILES

MAP BASED ON STATE OF NEW HAMPSHIRE - STATE OF MAINE HIGHWAY MAPS

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
BAXTER LAKE CENTER DIKE

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1978, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Anderson-Nichols & Company, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to Anderson-Nichols & Company, Inc. under a letter of May 3, 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0329 has been assigned by the Corps of Engineers for this work.

b. Purpose.

(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify, and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Baxter Lake is located in both the City of Rochester and the Town of Farmington, New Hampshire. Baxter Lake Center Dike, together with the Main Dam, Westerly and Easterly Dikes impound Baxter Lake (formerly Meader Pond).

The Center Dike, as well as the other impounding barriers, are located in Rochester, New Hampshire. Baxter Lake forms the headwaters of Rickers Brook which is confluent with Howard Brook approximately 3 miles downstream. These two brooks combine to form Axe Handle Brook which flows 1.3 miles

to its confluence with the Cocheco River just north of Gonic, New Hampshire. The Cocheco River then flows southeasterly for a distance of about 16 miles to its confluence with the Piscataqua River. The Cocheco River is a major tributary in the Piscataqua River Basin. Baxter Lake Center Dike is shown on U.S.G.S. Quadrangle, Alton, New Hampshire with coordinates approximately at N 43° 19' 24", W 71° 02' 24", Strafford County, New Hampshire. (See Location Map page iv.)

b. Description of Dike and Appurtenances. Baxter Lake Center Dike is an earthen embankment with an 18-inch concrete core wall. The dike is now about 240 feet long, 12 feet wide at the crest, and 10 feet high above the downstream toe. As originally constructed, the earthen embankment was about 6 inches over the top of the concrete core wall. It was 135 feet long and only about 6 feet in height; however, the dike was widened and raised to its present height to provide an access road in 1942. Upstream, the dike is faced with riprap; brush is growing among the stones. The downstream face is sparsely covered with brush. The crest carries the unpaved access road. The dike has no other appurtenances.

c. Size Classification. Intermediate (Hydraulic height - 7 feet, storage - 1,720 acre-feet) based on storage ($\geq$1,000 to $<$50,000 acre-feet) as given in the OCE Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Significant hazard. A major breach would result in the loss of less than 10 lives and little property damage.

e. Ownership. Baxter Lake Center Dike, along with the Main Dam and Easterly Dike, were originally constructed in 1923 by the Gonic Manufacturing Company for the purpose of storage for hydroelectric generation as well as textile process water. Gonic Manufacturing Company transferred title to the access road over Center Dike to the State of New Hampshire, Fish and Game Department January 24, 1961. In the deed it states that the State of New Hampshire is in no way responsible for water level or maintenance of the dams on Baxter Lake. The deed also reserves the right for continued use of the dike as an access road to the Main Dam and lake. Therefore, Center Dike apparently is the property of and is maintained by Baxter Lake Recreation Area, Inc.

f. Operator. Walter Pheeney, W.T.P. Engineering, Baxter Lake, Rochester, New Hampshire 03867, Phone (603) 332-3733, is responsible for the operation of the Main Dam under the authority of the Baxter Lake Recreation Area, Inc.,

22 Concord Street, Nashua, New Hampshire 03060. Phone (603) 883-6363.

g. Purpose of Dike. Baxter Lake Center Dike, as well as the Main Dam and Easterly Dike, were originally constructed to provide industrial water storage for the Gonic Manufacturing Company in Gonic, New Hampshire. Baxter Lake was utilized as upstream storage for hydroelectric generation as well as textile process water. After 1959 its use was strictly as textile process water. Today, Baxter Lake is utilized for recreational purposes only.

h. Design and Construction History. L. E. Scruton, C. E., Portsmouth, New Hampshire, designed the dam and two dikes in 1921. He supervised the construction in 1922 and 1923. In 1941, Harrison G. White Engineers, Springfield, Massachusetts, designed the repairs for the Main Dam and Center Dike. The repairs were made in 1942. From the design plans and correspondence in the files of the New Hampshire Water Resources Board (NHWRB), fill was apparently added to the Center Dike to raise the grade and widen the dike to carry an access road. (See Appendix B.)

i. Normal Operational Procedures. Not applicable; Baxter Lake Center Dike has no outlet facilities. No written maintenance procedures were disclosed.

1.3 Pertinent Data

a. Drainage Area. The drainage area consists of 4 square miles (2,560 acres) of predominately steep-sloping wooded terrain.

b. Discharge at Dike

(1) Outlet works (conduits) - none

(2) The maximum known discharge at dike is unknown.

(3) Ungated spillway capacity at maximum pool elevation - not applicable

(4) Gated (stoplog) spillway capacity at recreational pool elevation - not applicable

(5) Stoplog spillway capacity at maximum pool elevation - not applicable

c. Elevation (ft. above MSL)

(1) Top of dike - 417.2

(2) Maximum pool - design surcharge - unknown

(3) Full flood control pool - not applicable

(4) Recreation pool - 413

(5) Spillway crest - not applicable

(6) Upstream portal invert diversion tunnel - not applicable

(7) Streambed at centerline of dike - 412 (downstream toe as measured at time of inspection)

(8) Maximum tailwater - unknown

d. Reservoir (miles)

(1) Length of maximum pool - 1.0

(2) Length of recreational pool - 1.0

(3) Length of flood control pool - not applicable

e. Storage (acre-feet)

(1) Recreation pool - 1,400

(2) Flood control pool - not applicable

(3) Design surcharge - unknown

(4) Top of dike - 1,720 (storage based on Easterly Dike)

f. Reservoir Surface (acres)

(1) Top of dike - 427

(2) Maximum pool - 324

(3) Flood control pool - not applicable

(4) Recreation pool - 316

(5) Spillway crest - not applicable

g. Dike

(1) Type - earth embankment with concrete core, rock facing on upstream slope

(2) Length - 240'

(3) Height - 10'

(4) Top Width - 12'-13'

(5) Side Slopes - 3H: 1V

(6) Zoning - unknown

(7) Impervious Core - 18-inch concrete core wall

(8) Cutoff - concrete core wall extends to unknown depth

(9) Grout Curtain - unknown

h. Diversion and Regulating Tunnel - not applicable

i. Spillway - none

SECTION 2
ENGINEERING DATA

2.1 Design

No original design data were disclosed for the structures impounding Baxter Lake.

2.2 Construction

Except for inspection reports and design drawings noted below, few other construction data were disclosed for the impounding structures on Baxter Lake. A search of the files of the NHWRB revealed three blueprint design plans dated 1921 and a plan of the reconstruction completed in 1942.

During construction in 1922, the following quotations, taken from reports by B. H. Moxon, State Inspector, were obtained from the files of the NHWRB, successor agency to the Public Service Commission of New Hampshire, the State Agency that was responsible in 1922 for approving plans and making inspections of dam construction:

> On Thursday, May 25, 1922, I made an inspection of the several locations where the Gonic Manufacturing Company intend to construct a dam and two dikes. The natural geographical conditions are such that a storage reservoir may be easily obtained.
>
> The site of the Main Dam is just upstream from an old rock-filled dam which was in use probably 75 years ago. It is expected that ledge foundation will be met for the whole distance of the Main Dam. Plans and specifications for this development are on file in the office of the Public Service Commission.
>
> L.E. Scruton of Portsmouth is the engineer and contractor, and the work is being done under contract. The foundation for the Main Dam was not exposed, but an examination

of the cut-off trenches for the dike walls showed that sufficiently impervious foundation was encountered on which to build the concrete cut-offs. The engineer was advised that he could proceed with the work as fast as possible, but was to advise us at such time as the foundation for the Main Dam was cleared. It is expected that a concrete mix of 1-2½-5 would be used on this work, the gravel being natural run of the bank and testing to that ratio. (Inspection 5/25/22)

On 4/28/23, Gonic Manufacturing Company informed the Public Service Commission that the work was complete and the pond was filled. (See Appendix B.)

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

a. Availability. Little engineering data were disclosed for the structures impounding Baxter Lake. A search of the files of the NHWRB revealed only a limited amount of recorded information.

b. Adequacy. Because of the limited amount of detailed data available, the final assessments and recommendations of this investigation are based on visual inspection and hydrologic and hydraulic calculations.

c. Validity. The plans found for the construction in 1921-1922 and rehabilitation completed in 1942 are in general conformity with the structure as seen in the visual inspection. (For details, see Sections 3 & 6 and Appendix B.)

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The Center Dike is a small dike in height but is classified as intermediate because of the size of the impoundment of Baxter Lake. A well-defined valley leads downstream of the Center Dike and this valley is tributary to the channel downstream from the Main Dam. The watershed above the reservoir is gently to steeply sloping and heavily wooded. There are cottages, homes, and trailers around the perimeter of the lake. The lake level is controlled at the Main Dam.

b. Dike. The Center Dike consists of an earthen embankment, 240 feet long, and 12 feet wide at the crest. Design drawings and inspection reports show that it has a concrete core wall - 18 inches wide, extending to an unknown depth, and with its top buried beneath fill under the crest of the dike. Only the earthen embankment is visible. The crest of the dike was approximately 5 feet above the lake level at the time of the inspection. The upstream face of the dike is covered with riprap and dense brush. (See Appendix C - Figure 2.) An unpaved road crosses the dike along the crest. (See Appendix C - Figure 3.) The downstream slope is sparsely covered with brush. (See Appendix C - Figure 4.) One area of minor seepage was observed at the downstream toe of the dike near the east abutment (discharge .001 cfs). (See Appendix C - Figure 5.)

c. Appurtenant Structures. The control structures for Baxter Lake are part of the Main Dam.

d. Reservoir Area. The reservoir slopes are gently sloping and covered with trees and brush. There are some houses, cottages, and trailers along the shoreline. They appear to be sited 4 to 6 feet above the lake level. An extensive trailer-site development is currently underway on the slopes around the lake. Little sedimentation was observed in the reservoir.

e. Downstream Channel. A well-defined valley leads downstream of the dike and this valley is tributary to the Rickers Brook channel downstream of the Main Dam.

3.2 Evaluation

Based on the visual inspection, the condition of the Center

Dike on Baxter Lake is good. One minor seepage was observed at the downstream toe near the east abutment; it is not considered to be an immediate problem but should be monitored. Brush is growing extensively on the upstream slope and sparsely on the downstream slope. The crest of the dam carries an unpaved roadway. None of these conditions appear to pose any immediate threat to the stability of the dike.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No written operational procedures were disclosed. Baxter Lake Main Dam and its overflow spillway are the controlling structures in maintaining the normal lake level throughout the year. Because of the difference in ownership of the Main Dam and Center Dike and of Easterly Dike, the operation and maintenance of the controlling structures are directly related to the conditions they may impose upon the other impounding barriers. A verbal agreement exists between Baxter Lake Recreation Area, Inc. and Lancelot Shores Home Owners Association in Farmington, New Hampshire regarding the level of Baxter Lake. The agreement simply is to maintain the level at recreational (normal) pool throughout the year. The pool level is primarily controlled by operation of the sluice gate.

4.2 Maintenance of Dam

Baxter Lake Center Dike is maintained by the Baxter Lake Recreation Area, Inc.

4.3 Maintenance of Operating Facilities

Not applicable.

4.4 Description of Any Warning System in Effect

No written warning system was disclosed. However, Lonnie Pevear, (603) 332-3600, a maintenance man who works daily at Baxter Lake Recreation Area, is on call at all times to operate the sluice gate. The Easterly Dike is carefully watched by Harry Baxter, owner of the Easterly Dike, for potential overtopping and Lonnie Pevear is contacted when this situation is approached.

4.5 Evaluation

Maintenance and operating procedures should be improved. Although present procedures may satisfy daily normal operations, they are not adequate for an emergency that could be produced by a major storm with high runoff.

SECTION 5
HYDROLOGY AND HYDRAULIC ANALYSIS

5.1 Evaluation of Features

a. Design Data. Design plans of the original construction of the Main Dam and two dikes dated 1921 and the reconstruction plans for the Main Dam and Center Dike along with the limited hydrologic and hydraulic information were obtained from the files of the NHWRB. The above information was assessed to determine its acceptability in evaluating the overtopping potential of the structures impounding Baxter Lake.

Baxter Lake Center Dike is classified as being intermediate in size having a maximum storage of 1,720 acre-feet.

To determine the hazard classification for Baxter Lake Center Dike, the impact of failure of the dam at maximum pool was assessed using Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers. The analysis covered the reach extending from the dam to Meaderboro Corner on State Route 202A, a distance of about 1.9 miles. Failure of Baxter Lake Center Dike at maximum pool would probably result in an increase in stage of 5.1 feet along the reach. An increase in water depth of this magnitude would probably result in the loss of less than 10 lives, sever Ten Rod Road 0.4 miles downstream of the dike, and cause little other property damage.

As a result of the analysis described above, Baxter Lake Center Dike was classified - Significant Hazard. Using OCE Recommended Guidelines for Safety Inspection of Dams, the recommended spillway test flood is the Probable Maximum Flood. The test flood discharge for Baxter Lake Center Dike, having a drainage area of 4 square miles, was determined to be 2850 cfs.

b. Experience Data. No information regarding past overtopping of Center Dike was found.

c. Visual Observation. No visual evidence of damage to the structure that might have been caused by overtopping was found at the time of inspection. The crest of the dike, forming an unpaved access road, was approximately 5 feet above the lake level at the time of inspection. The upstream face is covered with riprap and is extensively covered with brush. The downstream slope is sparsely covered with brush.

d. <u>Overtopping Potential</u>. Baxter Lake Center Dike, along with the Easterly and Westerly Dikes, and the Main Dam, form the system of barriers which impound Baxter Lake. Baxter Lake Center Dike would not be overtopped by the test flood. The calculated test flood elevation is at least one foot lower than the low point of the crest of the dike. However, other dikes in the impounding system would be overtopped.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. Visual inspection did not indicate any existing structural problems in the dike. One minor seepage was observed at the downstream toe near the east abutment. Brush is growing extensively on the upstream slope and sparsely on the downstream slope. There is an unpaved roadway on the crest of the dike.

b. Design and Construction Data. One design drawing dated 1921 and inspection reports show that the dike was constructed with earthfill and has an 18-inch wide concrete core wall extending from an elevation about 6 inches below the crest to an unknown depth. No other design and construction data are available except the inspection reports. (See Appendix B.)

c. Operating Records. No operating records were disclosed.

d. Post-Construction Changes. Additional fill was placed in 1942 to carry the access road.

e. Seismic Stability. This dike is in Seismic Zone 2 and hence does not have to be evaluated for seismic stability according to the OCE Recommended Guidelines.

SECTION 7
ASSESSMENTS, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dike Assessment

a. Condition. The visual inspection indicates that the Center Dike on Baxter Lake is in good condition.

Three minor conditions should receive attention:

(1) minor seepage at the downstream toe near the east abutment;

(2) brush growing on the upstream and downstream slopes; and

(3) potential erosion of the unpaved roadway on the crest of the dike.

b. Adequacy of Information. The information available is such that the assessment of the condition of the dike must be based primarily on the visual inspection.

c. Urgency. The recommendation in 7.2 below should be implemented within 4 years. The operational and maintenance procedures should be implemented within one year.

d. Need for Additional Information. The information obtained and the visual inspection are adequate for purposes of this evaluation.

7.2 Recommendations

The owner should retain the services of a registered professional engineer to design remedial measures for elimination or control of the seepage at the downstream toe near the east abutment.

7.3 Remedial Measures

a. Alternatives. None recommended (however, see Main Dam report).

b. Operation and Maintenance Procedures.

(1) The upstream slope, downstream slope, and an area 25 feet downstream of the dike should be cleared and maintained free of brush and trees.

(2) The crest roadway should be monitored for erosion and necessary remedial action taken if erosion should start.

(3) The seepage at the downstream toe of the dike should be monitored on a weekly basis.

(4) A surveillance and warning program should be established to follow in the event of flooding.

APPENDIX A

CHECK LIST - VISUAL INSPECTION

PERIODIC INSPECTION

PARTY ORGANIZATION

PROJECT Baxter Lake, New Hampshire
Center Dike

DATE June 14, 1978

TIME 2:00 P.M.

WEATHER Cool, windy, partly cloudy

W.S. ELEV. 412.7 U.S. 407.1 DN.S.

(feet MSL)

PARTY:

1. Warren Guinan	6.
2. Stephen Gilman	7.
3. Leslie Williams	8.
4. Ronald Hirschfeld	9.
5.	10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrology/Hydraulics	W. Guinan/L. Williams	
2.	Structural Stability	S. Gilman	
3.	Soils & Geology	R. Hirschfeld	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT Baxter Lake, New Hampshire DATE June 14, 1978

PROJECT FEATURE Center Dike NAME

DISCIPLINE Structural and Soils/ Geology NAME

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	
Crest Elevation	417.2
Current Pool Elevation	412.7
Maximum Impoundment to Date	Unknown
Surface Cracks	None visible
Pavement Condition	Not paved
Movement or Settlement of Crest	None visible
Lateral Movement	None
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good (abutment); core wall not visible
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	Unpaved roadway on crest
Sloughing or Erosion of Slopes or Abutments	None
Rock Slope Protection - Riprap Failures	None
Unusual Movement or Cracking at or near Toes	None
Unusual Embankment or Downstream Seepage	Seepage close to toe of dike near east abutment
Piping or Boils	None
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

PROJECT Baxter Lake Main Dam	DATE June 14, 1978
PROJECT FEATURE Reservoir	NAME L. Williams

AREA EVALUATED	REMARKS
Stability of Shoreline	Good
Sedimentation	No visible problems
Changes in Watershed Runoff Potential	Minor
Upstream Hazards	Many homes; lowest is 4' above lake
Downstream Hazards	Footbridge, Ten Rod Road, and Meaderboro Corner on State Route 202A
Alert Facilities	None observed
Hydrometeorological Gages	None
Operational & Maintenance Regulations	None observed

APPENDIX B

INSPECTION REPORTS/SKETCHES

BAXTER CENTER DIKE

March 21, 1977

Donald M. Rapoza

Baxter Lake Dam Nos. 204.09, 204.10, & 204.11

At 6:15 a.m. on March 14, 1977 I received a call from Mrs. Baxter informing me that water was going over the dike and a section of their property and their basement was flooded.

I contacted William Rickey, the owner of the property & Rickey Company, and requested that he make provisions to inspect the property and take the necessary measures to alleviate the flooding conditions. I met Mr. James Nass, project engineer for the Rickey Company and together we viewed the dikes, spillway, and dam and found the following:

Dam (#204.11)

Water was 10 inches over the upstream concrete wall and 2 feet below the top of dam. The platform for the gate lifting mechanism was submerged.

Spillway

Water was 11" above the concrete abutments. Steel beam was not removed and restricting the discharge from the pond.

Dike (#204.10)

No visible problem with the dike. Approximately 5 feet freeboard.

Dike (#204.09)

Found the dike was being topped (approximately 1 inch) at midpoint between the abutments and at Mr. Baxter's property, section 27 feet long and 57" max. depth. I also found a longitudinal surfact crack almost the entire length of the dikes.

Mr. Nass and I also viewed the two major roads downstream of the structure for additional discharge capacity from Baxter Lake and it was decided after some discussion that the owners were going to lower the lake probably though the gate section and monitor the roadway immediately downstream of the structure to minimize any roadway flooding.

I made mention that the owner was liable for damages caused by his management of lake levels or discharges and strongly suggested that he remove the steel beam located between the concrete abutments in the spillway as the beam was restricting flow from the lake and causing problems with private property and the dike.

While at Mr. Baxter's property I placed two nails into two pines to establish a high water mark and requested that Mr. Baxter measure the water level the following day. I called Mr. Baxter on March 15, 1977 and he reported that the lake had receded approximately 5 inches.

M E M O

From: Donald Rapoza, Civil Engineer October 29, 1976

To: Vernon Knowlton, Chief Engineer

SUBJECT: INSPECTION OF DAM AND DIKES AT OUTLET OF BAXTER LAKE IN ROCHESTER

DAM # 204.09 - #204.10 - #204.11

As requested I inspected the dam and dikes on September 17, 1976, at the outlet of Baxter Lake in Portsmouth, N.H.

The dam is presently owned by Richie Builder Associates of Barnstead, N.H. Mr. Richie and Mr. James Fitzpatrick met me at the site and we reviewed the dam and dike and I pointed out some of the following maintenance items which needed their attention:

Dam #204.11 (Main Structure and Spillway)

1. Gate Lifting Mechanism - Someone has removed parts of the gate lifting mechanism making the gate inoperable. Calculations in our files indicate that flow through the gate is required to pass the 100-year storm.

2. Some concrete is spalling on the upstream facing of the dam.

3. There is a small amount of seepage on the downstream side of dam adjacent to the principal spillway pipe which should be monitored.

4. Expansion joints should be repaired and filled with joint filler.

Spillway - The flashboards and pins were removed and a 10 x 27 I Beam was placed between the spillway abutments.

Dam #204.10 (Center Dike)

1. Trees and other woody growth should be removed from the upstream and downstream faces of the dam.

2. There is seepage located at the left abutment on the downstream side of the structure. It is not critical at this time but the owner should be made aware of the potential problem and the area monitored by the owner and the results reported to our office yearly or when any appreciable increases are found at the site.

Dam #204.09 (Lower Dike adjacent to Baxter Property)

1. Trees and all woody growth should be removed from the top and both sides of the structure.

2. Seepage along the toe of the structure should be monitored.

3. Damaged dike areas should be repaired. Mr. Baxter reported that he repaired the dike sometime ago when the dike was breached.

OPERATIONS RECOMMENDATIONS:

The lake should be drawn down to the permanent crest of the spillway section after the recreation season and the boards replaced after spring runoff.

DMR:L

BAXTER CENTER DIKE
26 July 1950

NEW HAMPSHIRE WATER CONTROL COMMISSION

REPORT ON DAM INSPECTION

TOWN Rochester DAM NO. 204.10 STREAM

OWNER Gonic Mfg. Co. ADDRESS Gonic, N.H.

In accordance with Section 20 of Chapter 133, Laws of 1937, the above dam was inspected by me on 26 July 1950 accompanied by

NOTES ON PHYSICAL CONDITION

Abutments Good (GOOD)

Spillway None (a spillway)

Gates None (a dike)

~~Other~~ Embankment:

CHANGES SINCE LAST INSPECTION Rebuilt in 1941-1942 (REBUILT IN 1941-1942)

FUTURE INSPECTIONS Yes (YES)

This dam (is) ~~(is not)~~ a menace because of pondage (of pondage)

REMARKS Pond down about 18" from spillway elev.

Copy to Owner	Date

INSPECTOR

(Additional Notes Over)

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON DAMS IN NEW HAMPSHIRE

LOCATION — STATE NO. 204.10

Town: Rochester ✓ : County: Strafford

Stream: Header [illegible] ✓ (Center Dike)

Basin-Primary: OCean : Secondary: ~~[illegible]~~ [illegible] Brook

Local Name: Center Dike

Coordinates—Lat. 43° 20' ± 4800 : Long. 71° 0' ± 5000

GENERAL DATA

Drainage area: Controlled .... Sq. Mi.: Uncontrolled .... Sq. Mi.: Total ~~1.8~~ 3.3 Sq. Mi.

Overall length of dam 145 ft.: Date of Construction ....

Height: Stream bed to highest elev. 7 ft.: Max. Structure 5'6" ft.

Cost—Dam .... : Reservoir ....

DESCRIPTION: Gr vity earth and concrete Foundation earth

Waste Gates

Type ....

Number .... : Size .... ft. high x .... ft. wide

Elevation Invert .... : Total Area .... sq. ft.

Hoist ....

Waste Gates Conduit

Number .... : Materials ....

Size .... ft.: Length .... ft.: Area .... sq. ft.

Embankment

Type: Conc. core with Earth ~~[illegible]~~

Height—Max. 7 ft.: Min. .... ft.

Top—Width 12½ 12' : Elev. .... ft.

Slopes—Upstream 1 ~~[illegible]~~ on 2 : Downstream 1 on 2½ ±

Length—Right of Spillway — : Left of Spillway —

Spillway

Materials of Construction: Spills over main dam

Length—Total none ft.: Net .... ft.

Height of permanent section—Max. .... ft.: Min. .... ft.

Flashboards—Type .... : Height .... ft.

Elevation—Permanent Crest .... : Top of Flashboard ....

Flood Capacity .... cfs.: .... cfs/sq. mi.

Abutments

Materials: ....

Freeboard: Max. .... ft.: Min. .... ft.

Headworks to Power Devel.—(See "Data on Power Development")

OWNER: Gonic Mfg. Co.

REMARKS: Condition fair Subject to inspection
Use conservation
[illegible] (Pg. [illegible] [illegible]).

Tabulation By: G.S.W. Date ....

4B21294

PUBLIC SERVICE COMMISSION OF NEW HAMPSHIRE—DAM RECORD I-4022

TOWN	Rochester	TOWN NO. 10	STATE NO 28476
RIVER STREAM	Meader Pond - Center Dike		
DRAINAGE AREA	1.6	POND AREA	
DAM TYPE	Gravity	FOUNDATION NATURE OF	Earth
MATERIALS OF CONSTRUCTION	Earth, Concrete		
PURPOSE OF DAM	POWER—CONSERVATION—DOMESTIC—RECREATION—TRANSPORTATION—PUBLIC UTILITY		
HEIGHTS, TOP OF DAM TO BED OF STREAM	7'	TOP OF DAM TO SPILLWAY CRESTS	18"
SPILLWAYS, LENGTHS DEPTHS BELOW TOP OF DAM		LENGTH OF DAM	145'
FLASHBOARDS TYPE, HEIGHT ABOVE CREST			
OPERATING HEAD CREST TO N. T. W.		TOP OF FLASHBOARDS TO N. T. W.	
WHEELS, NUMBER KINDS & H. P.			
GENERATORS, NUMBER KINDS & K. W.			
H. P. 90 P. C. TIME 100 P. C. EFF.		H. P. 75 P.C. TIME 100 P. C. EFF.	
REFERENCES, CASES, PLANS, INSPECTIONS.			

REMARKS

OWNER- Gonic Mfg. Co.

CONDITION- Fair

MENACE- Yes. Will be subject to periodic inspection.

[illegible]

To the Public Service Commission:

The foregoing memorandum on the above dam is submitted covering inspection made November 19, 1935, according to notification to owner dated November 16, 1935, and bill for same is enclosed

Nov. 25, 1935
Copy to Owner

Samuel J. Lord
Hyd. Eng.

11/19/35 C.

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Ocean NO. 10 — 58 — 5-4322
RIVER Meader Pond MILES FROM MOUTH D.A.SQ.MI. 1.6
TOWN Rochester OWNER [illegible]
LOCAL NAME OF DAM Center Dike
BUILT DESCRIPTION Gravity — Earth Concrete in Earth

POND AREA-ACRES DRAWDOWN FT. POND CAPACITY-ACRE FT.
HEIGHT-TOP TO BED OF STREAM-FT. 7 MAX. MIN.
OVERALL LENGTH OF DAM-FT. 145 MAX.FLOOD HEIGHT ABOVE CREST-FT.
PERMANENT CREST ELEV.U.S.G.S. LOCAL GAGE
TAILWATER ELEV.U.S.G.S. LOCAL GAGE
SPILLWAY LENGTHS-FT. None (NONE) FREEBOARD-FT.
FLASHBOARDS-TYPE, HEIGHT ABOVE CREST
WASTE GATES-NO. WIDTH MAX. OPENING DEPTH SILL BELOW CREST

REMARKS Condition Fair Spills over Main Dam
(Condition Fair) (Spills over Main Dam)

POWER DEVELOPMENT

UNITS	NO.	RATED HP	HEAD FEET	C.F.S. FULL GATE	KW	MAKE

USE Conservation (Conservation)

REMARKS Menace (Menace)

DATE 11/19/35

PUBLIC SERVICE COMMISSION

OF

NEW HAMPSHIRE

LLIAM T. GUNNISON, CHAIRMAN
OMAS W. D. WORTHEN
HN W. STORRS
COMMISSIONERS

WALTER H. TIMM, CLERK
MISS MARY A. NAWN
ASSISTANT CLERK

CONCORD May 31, 1922.

Hon. John W. Storrs, Commissioner,
Public Service Commission,
Concord, New Hampshire.

Dear Sir:-

In re: The Gonic Manufacturing Company dam at Rochester, New Hampshire.

On Thursday, May 25, 1922, I made an inspection of the site of the development being carried on for the Gonic Manufacturing Company.

The foundation for dams Nos. 2 and 3 had been mostly uncovered, and although practically no ledge was encountered in the trench for the cut-off wall, I believe the intended foundation is impervious and thoroughly substantial to put the proposed concrete cut-off on. I advised Mr. Scruton, the engineer, that he could proceed with the work on dams Nos. 2 and 3 according to the plans filed with the Public Service Commission.

In conference with Mr. Scruton regarding the spillway capacity of dam No. 1 it was decided that it would be well to augment the proposed spillway capacity by putting in an auxiliary 20-foot overflow to be made at a location near dam No. 1. The top elevation of this overflow would be not more than 6 inches above the

top of the main spillway, resulting in the availability of two spillways when water was impounded 6 inches over the primary spillway. The foundation of dam No. 1 was not uncovered, but we will be advised when such is ready for inspection.

The gravel to be used in the concrete mix is the natural run of the bank and appears to be of a specially good quality. Mr. Scruton is personally in charge of all construction and is living at the site. The cement to be used has been stored at the dam, and sample concrete blocks have been made to determine the best mix from the available gravel.

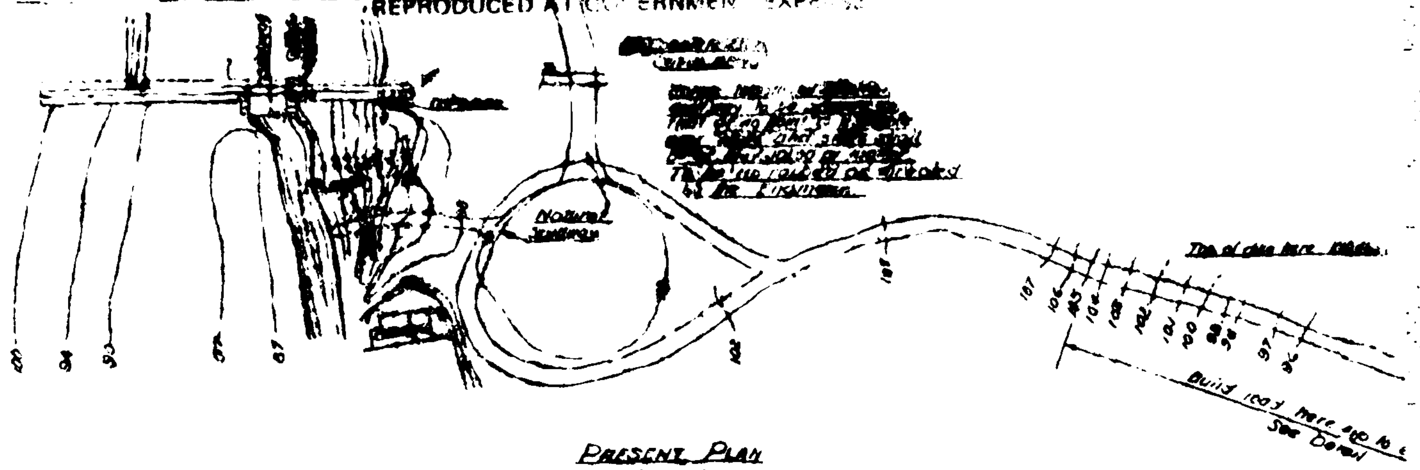
A later inspection of the foundation of dam No. 1 will be made and a report submitted.

Very truly yours,

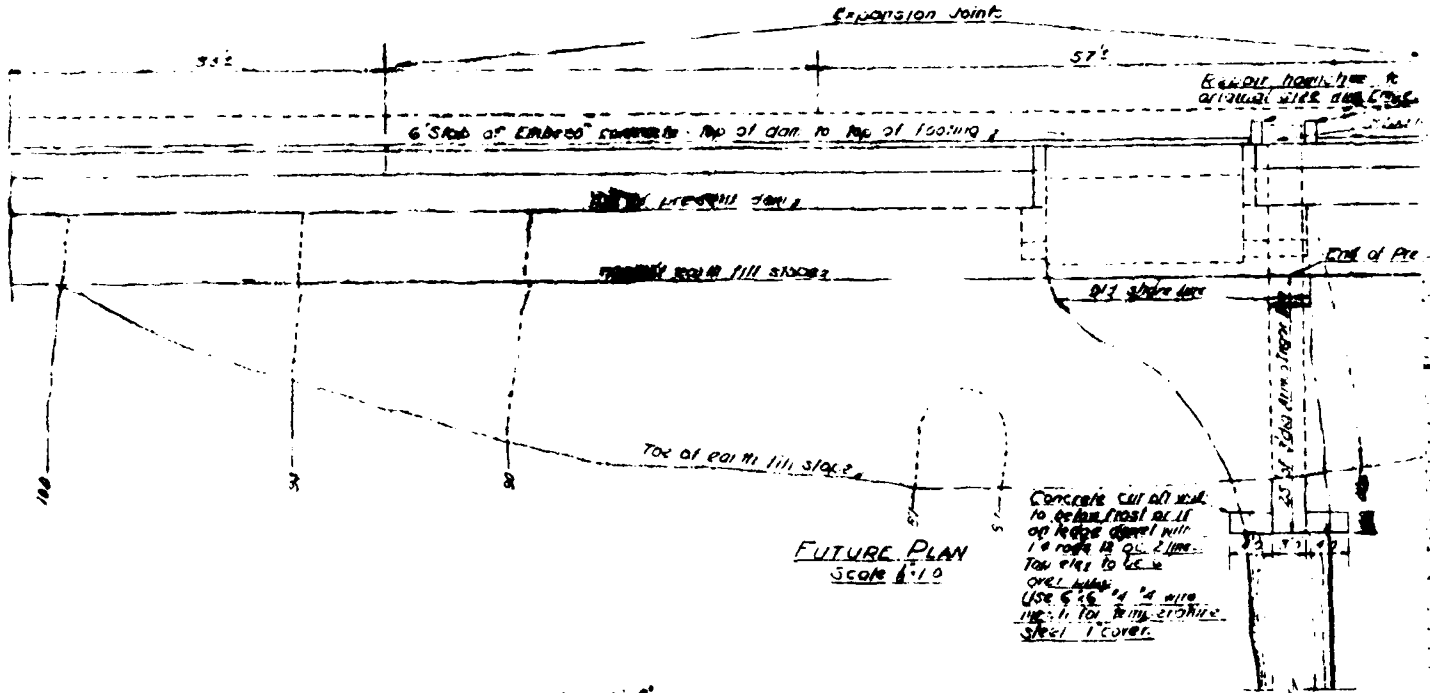
B. H. Moxon.

Inspector.

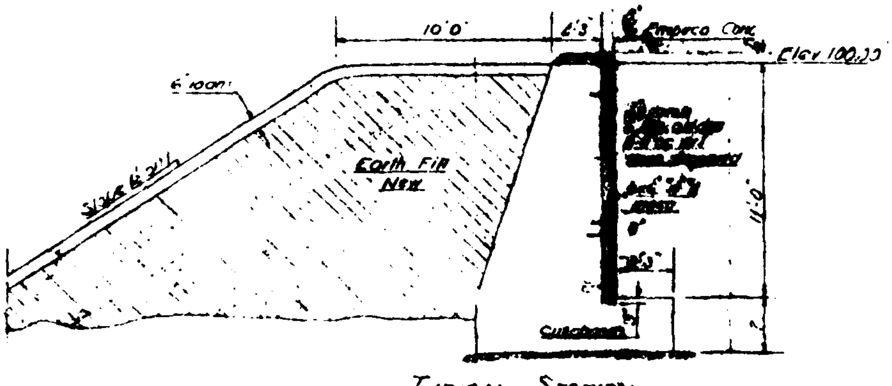
BHM:HVW



PRESENT PLAN



FUTURE PLAN
Scale 1"=10'



TYPICAL SECTION
Scale 1"=1'0"

NOTE

All loose concrete or that showing signs of [illegible] shall be removed by chipping with hammer or air operated tool. All concrete not showing signs of disintegration shall be vigorously wire [illegible] to remove all signs of surface film, laitance [illegible] matter.

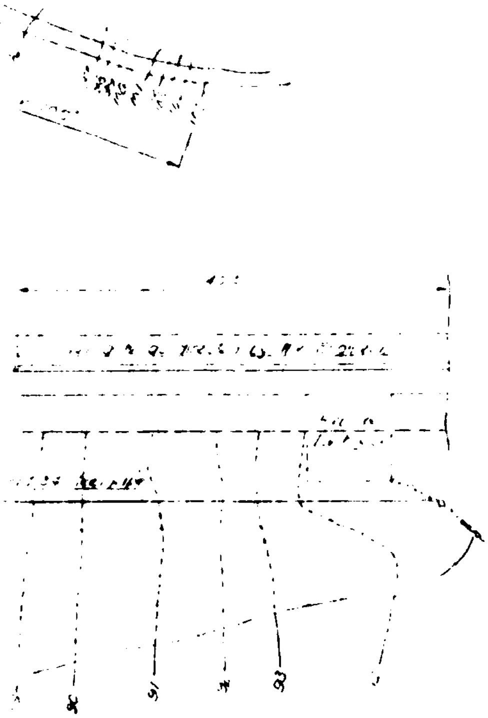
All openings shall be chipped so the sides [illegible] approximately perpendicular to the [illegible] and forming at least a 1" shoulder [illegible] shall be cut around and forced back [illegible] surface of [illegible]

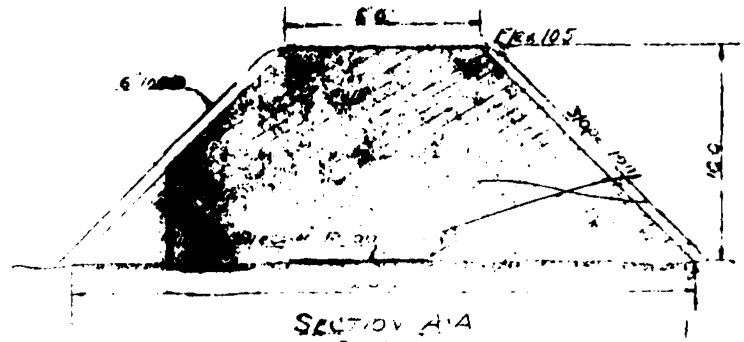
Drill and set [illegible] 3'0" o.c. [illegible] staggered [illegible] into drilling [illegible] remove all [illegible] drilling with large quantities of [illegible] wire mesh reinforcing to the [illegible]

Set forms of half the total height [illegible] ready to be put up [illegible] Pour the first half and then set [illegible] the forms and pour the second [illegible] the first before the initial set [illegible] eliminate any horizontal joint in the [illegible]

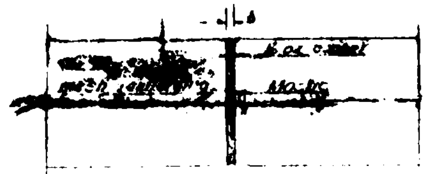
142

OF ROAD





SECTION A-A



APPROXIMATE QUANTITIES

22

39

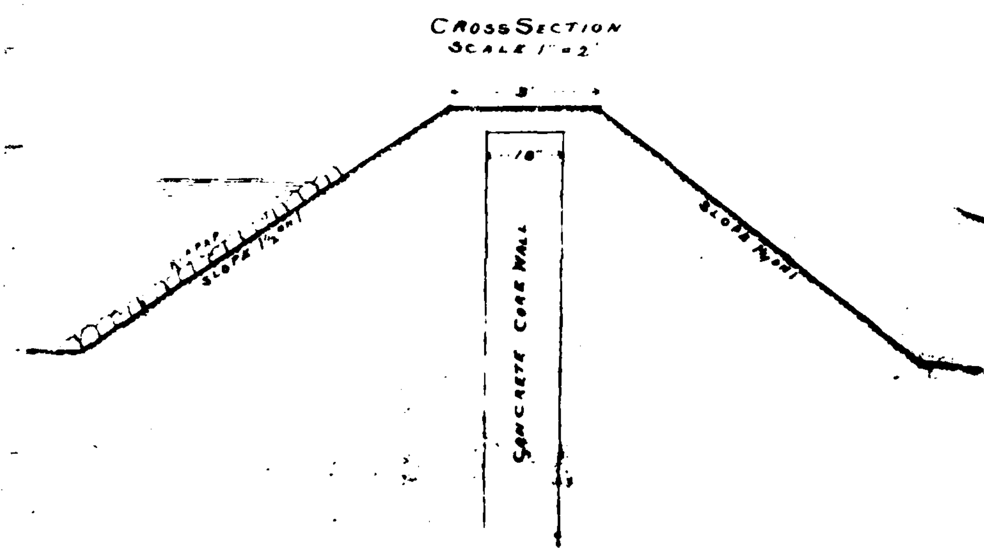
During the twelve hours preceding any pour have the surface of the dam soaked with water three or four times to ... surface to ...
The concrete mix shall be as follows
1 bag cement
2 cu ft sand
... cu ft gravel
34 lbs ...
4 gals water ...

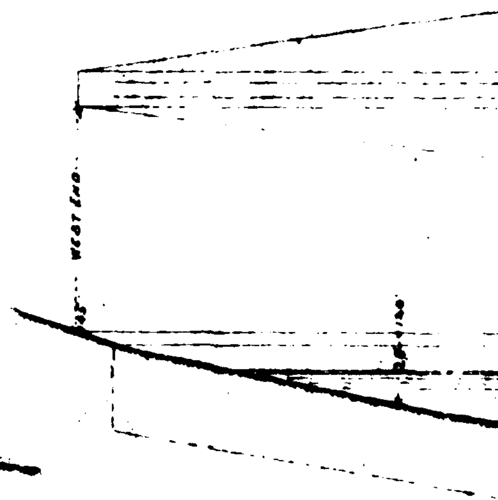
It is important that the concrete be well spaded in the forms

REVISED	Elev. ... 4
	HARRISON ... WHITE ENGINEERS ... MASS.
	REPAIRS TO DAM AND CHANGES IN ROADWAY GONIC MFG. CO GONIC, N.H.
	DES BY ... CHKD BY ... SCALE AS SHOWN
	DRN BY GAS ... APPD BY ... DATE 9-22-41
PRINTED 9/22/41	DWG. NO D 1656-1

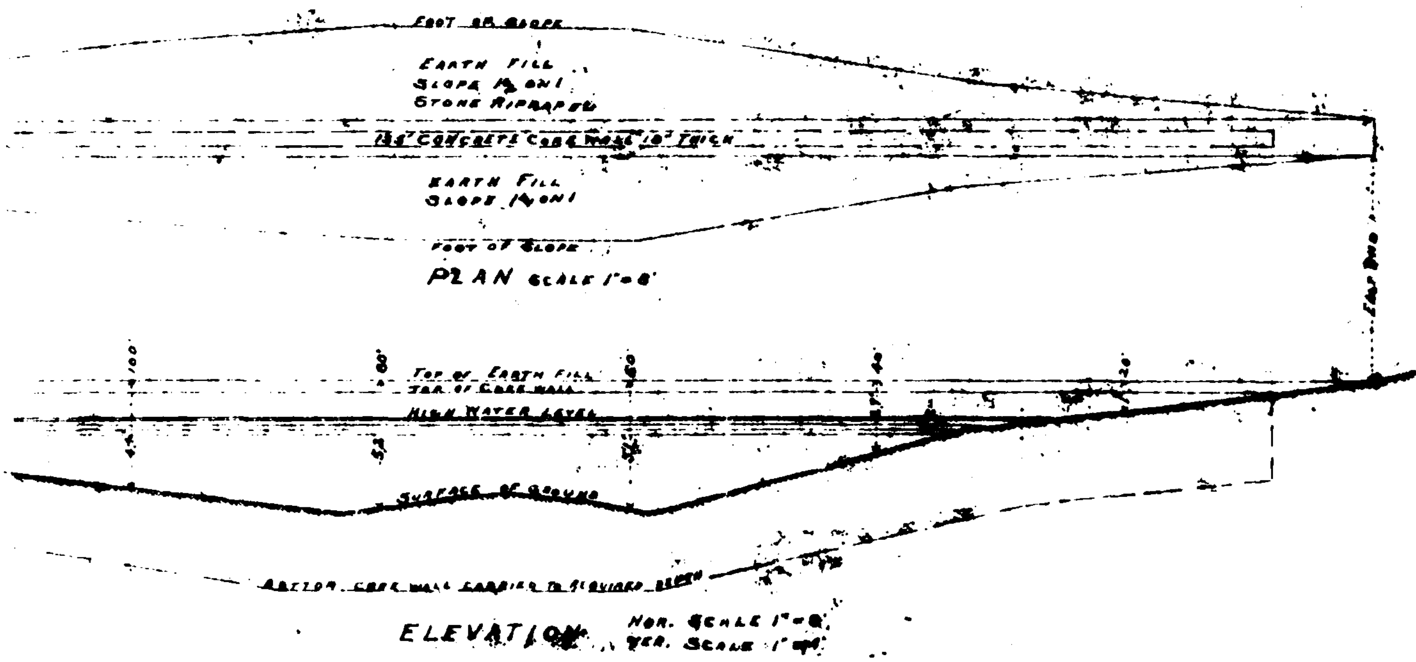
BAXTER LAKE

MAKE LINE
Reduce 5½" to 3"





147

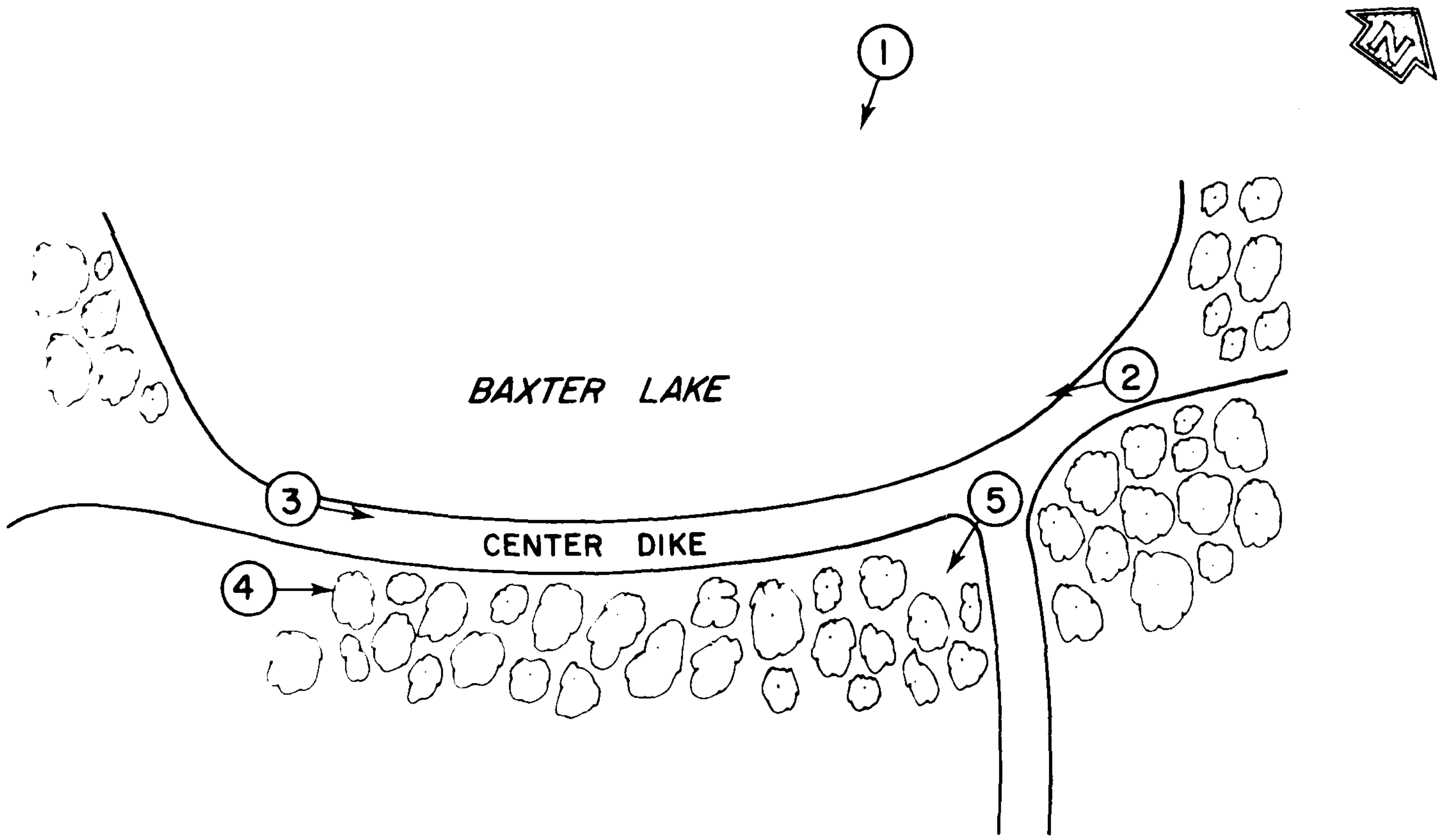


DAM NUMBER TWO

722

APPENDIX C

PHOTOGRAPHS



Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BAXTER LAKE CENTER DIKE
PHOTO INDEX

BAXTER LAKE — NEW HAMPSHIRE

SCALE: NOT TO SCALE
DATE: AUGUST 1978

Figure 2 - Looking southwest across the upstream face of the dike from the northeast bank.

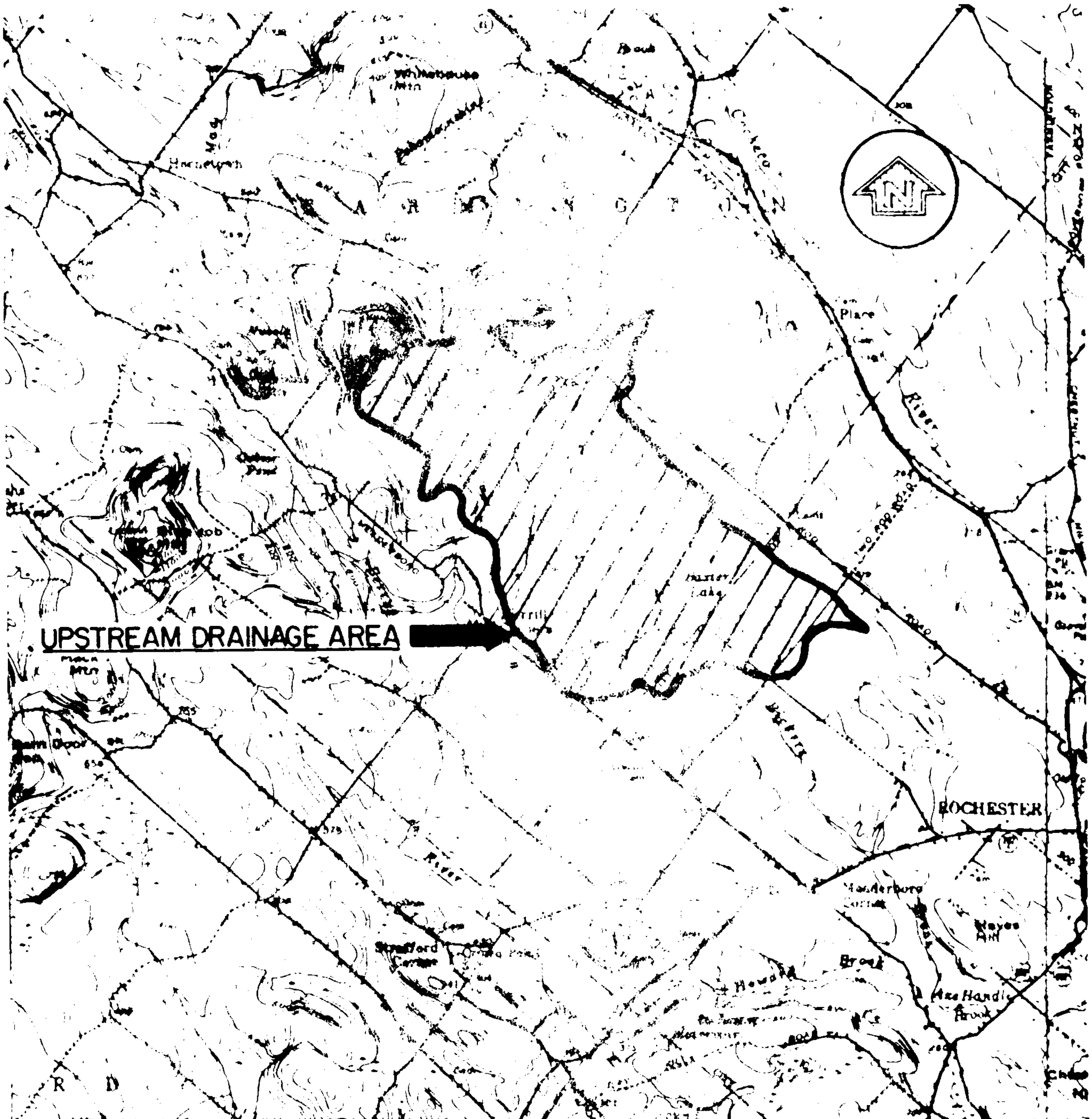
Figure 3 - Looking northeast across the top of the dike from the southwest end.

Figure 4 - Looking northeast across the down-stream face of the dike from the southwest end.

Figure 5 - Seepage at the downstream toe of the northeast end of the dike.

APPENDIX D

HYDROLOGY/HYDRAULICS



NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BAXTER LAKE CENTER DIKE

ROCHESTER, NEW HAMPSHIRE

REGIONAL VICINITY MAP

JULY 197[illegible]

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

ANDERSON-NICHOLS & CO., INC.

SCALE IN MILES

0 1 2

MAP BASED ON U.S.G.S. 15 MINUTE QUADRANGLE SHEET AT [illegible]

DA = 3.98 mi^2
Size Classification = Intermediate
Hazard Classification = Significant
Inspection Flood = ½PMF to PMF

Step #1
Calculate PMF using "Preliminary Guidance For Estimating Maximum Probable Discharges in Phase I Dam Safety Investigations, March 1978."

Use Flat & Coastal

@3.98 mi^2 P.M.F. in cfs/mi^2 = 840

P.M.F. Baxter Lake is:

840 cfs/~~mi^2~~ x 3.98 ~~mi^2~~ = 3343 cfs

Peak Inflow = 3345 cfs

Assumptions:
36" gate @ base of dam closed
Overflow spillway flashboards in - assuming they will not fail at PMF

C Values

Overflow Spillway (sharp crested weir)	4.0
Easterly Dike	2.8
Westerly Dike	2.8
Center Dike	2.7
Main Dam	2.7

JARES IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Step #2a:
Determine Surcharge Height to Pass "Qp1" of 3345 cfs.

TRIAL #1
Assume Elevation of 415.0

$Q_{OVERFLOW\ SPILLWAY} = CLH^{3/2}$

$Q = 4.0(18)(0.25)^{3/2} + 4.0(\tfrac{1}{2}\,8)(1.75)^{3/2} + 4.0(\tfrac{1}{2}\,7)(1.75)^{3/2} + 4.0(22)(1.75)^{3/2}$
$= 9 + 37 + 32 + 204$
$= 282$ cfs

$Q_{EASTERLY\ DIKE} = CLH^{3/2}$
$Q = 2.8(\tfrac{1}{2}\,21)(1)^{3/2} + 2.8(\tfrac{1}{2}\,25)(1)^{3/2} + 2.8(\tfrac{1}{2}\,100)(1)^{3/2} + 2.8(\tfrac{1}{2}\,50)(0.5)^{3/2} + 2.8(50)(0.5)^{3/2} + 2.8(100)(0.5)^{3/2} + 2.8(\tfrac{1}{2}\,100)(0.3)^{3/2} + 2.8(\tfrac{1}{2}\,20)(0.8)^{3/2}$
$= 29 + 35 + 140 + 25 + 50 + 99 + 23 + 20$
$= 421$ cfs

$Q_{TOT} = 282 + 421$
$= 703$ cfs

TRIAL #2
Assume Elevation of 416.0

$Q_{OVERFLOW\ SPILLWAY} = CLH^{3/2}$

$Q = 4.0(18)(0.25)^{3/2} + 4.0(\tfrac{1}{2}\,12)(2.75)^{3/2} + 4.0(\tfrac{1}{2}\,11)(2.75)^{3/2} + 4.0(22)(2.75)^{3/2}$

$= 9 + 109 + 100 + 401$
$= 619$ cfs

$Q_{\text{EASTERLY DIKE}} = CLH^{3/2}$

$$Q = 2.8(\tfrac{1}{2}43)(2.0)^{3/2} + 2.8(\tfrac{1}{2}25)(1)^{3/2} + 2.8(\tfrac{1}{2}100)(1)^{3/2} + 2.8(125)(1.0)^{3/2} + 2.8(150)(1.5)^{3/2} + 2.8(\tfrac{1}{2}50)(0.5)^{3/2} + 2.8(\tfrac{1}{2}100)(0.3)^{3/2} + 2.8(\tfrac{1}{2}50)(1.8)^{3/2}$$

$$= 170 + 35 + 140 + 350 + 772 + 25 + 23 + 169$$

$$= 1684 \text{ cfs}$$

$Q_{\text{WESTERLY EMBANKMENT}} = CLH^{3/2}$

$$Q = 2.8(\tfrac{1}{2}4)(0.5)^{3/2} + 2.8(\tfrac{1}{2}4)(0.5)^{3/2} + 2.8(200)(0.5)^{3/2}$$

$$= 2 + 2 + 198$$

$$= 202$$

$$Q_{TOT} = 619 + 1684 + 202$$

$$= 2505 \text{ cfs}$$

@ Elev. of 416.0
Contained by center dike
Contained by main dam embankment

TRIAL #3

Assume Elev. @ 416.3

Q overflow spillway = $CLH^{3/2}$

$Q = 4.0(18)(0.25)^{3/2} + 4.0(\tfrac{1}{2}\,13.5)(3.05)^{3/2} + 4.0(\tfrac{1}{2}\,12)(3.05)^{3/2} + 4.0(22)(3.05)^{3/2}$

$= 9 + 144 + 128 + 469$
$= 750$ cfs

Q easterly dike $= CLH^{3/2}$

$Q = 2.8(\tfrac{1}{2}\,50)(2.3)^{3/2} + 2.8(125)(1.3)^{3/2} + 2.8(150)(1.8)^{3/2} + 2.8(\tfrac{1}{2}\,25)(1.0)^{3/2} + 2.8(\tfrac{1}{2}\,100)(1.0)^{3/2} + 2.8(\tfrac{1}{2}\,50)(0.5)^{3/2} + 2.8(\tfrac{1}{2}\,100)(0.3)^{3/2} + 2.8(\tfrac{1}{2}\,56)(2.1)^{3/2}$

$= 244 + 519 + 1014 + 35 + 140 + 25 + 23 + 239$
$= 2239$ cfs

Q westerly embankment $= CLH^{3/2}$

$Q = 2.8(\tfrac{1}{2}\,18)(0.8)^{3/2} + 2.8(\tfrac{1}{2}\,20)(0.8)^{3/2} + 2.8(200)(0.8)^{3/2}$

$= 18 + 20 + 401$
$= 439$ cfs

416.3 @ top of main dam embankment
416.3 contained by center dike

$Q_{TOT} = 3428$ cfs

Surcharge Height to Pass PMF is 3.3' above overflow spillway (416.3 - 413.0 = 3.3') and 4.3' above permanent overflow spillway crest.

ARES N. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Step 2. b.

Determine Volume of Surcharge in Inches of Runoff

Normal Ac-Ft. Storage = 1400

Surface Area = 316 acres = 13764960 ft^2

Normal Pool @ Elevation 413.

'Frustrum of Pyramid

$V = \frac{1}{3} h \left(b_1 + b_2 + \sqrt{b_1 b_2}\right)$

h: elev. above normal pool

b_2: enlarged surface area in ft^2

b_1: normal pool surface area in ft^2

@ Elev. 420

Surface area = 461 acres = 20081160 ft^2

$V = \frac{1}{3}\, 7 \left(13764960 + 20081160 + \sqrt{13764960 \times 20081160}\right)$

$= \frac{1}{3}\, 7 \left(33846120 + 16625774\right)$

$= \frac{1}{3}\, 7 \left(50471894\right)$

$= 11.77677527 \times 10^7 \text{ ft}^3 \times \frac{1 \text{ acre}}{43560 \text{ ft}^2} = 2705 \text{ ac-ft}$

Surcharge Height to PASS PMF is 3.3'

Volume $= 5.3 \times 10^7$ ft^3

Spillway Volume = 0 ft^3

$5.3 \times 10^7 \text{ ft}^3 \times \frac{1}{3.98 \text{ mi}^2} \times \frac{1 \text{ mi}^2}{(5280)^2 \text{ ft}^2} = 0.48$ ft.

$0.5 \text{ ft.} \times 12 \text{ in/ft} = 5.73$ inches runoff

2c

$Qp_2 = Qp_1 \times \left(1 - \frac{\text{STOR}_1}{19''}\right)$

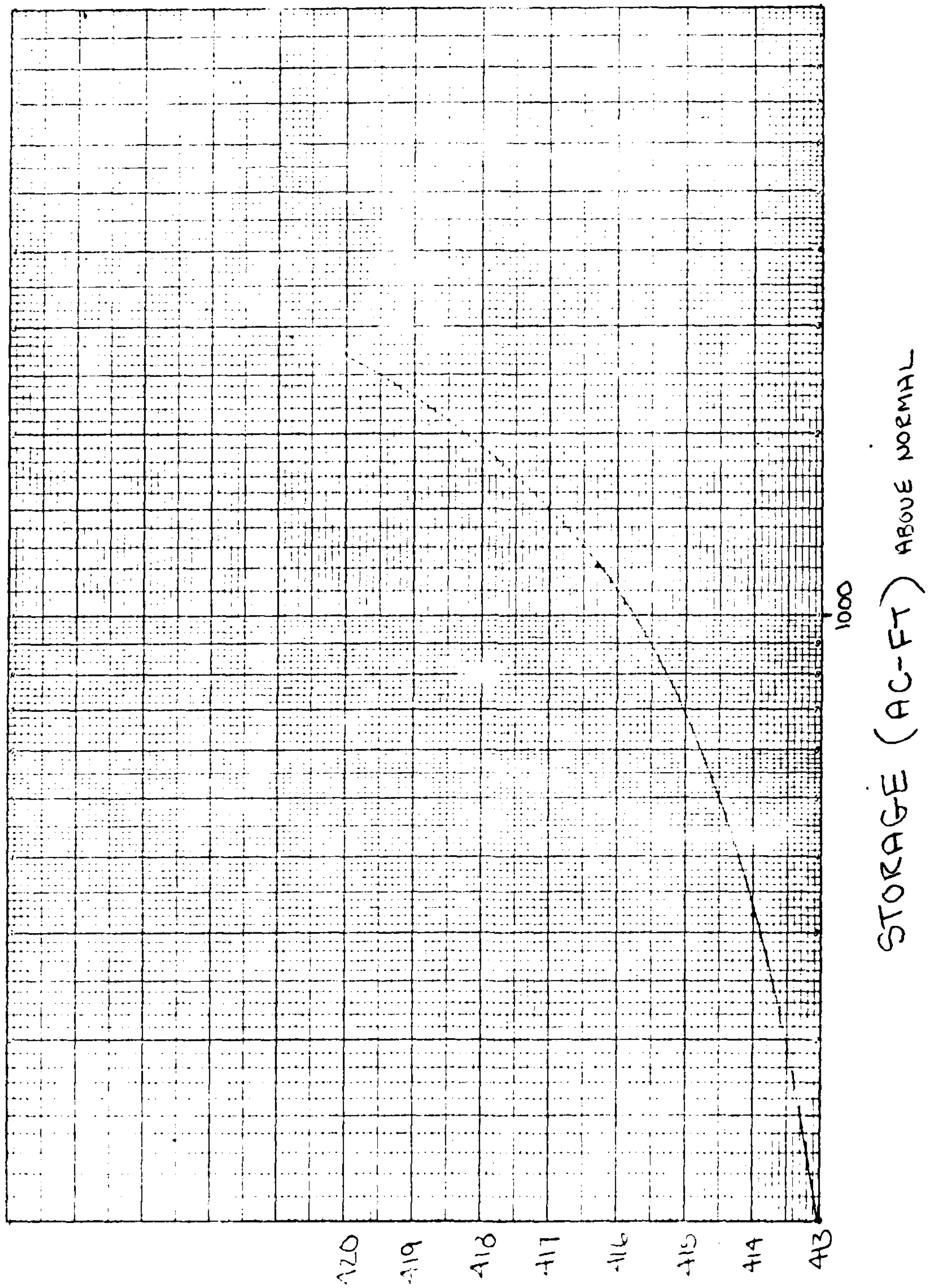
$Qp_2 = 3345 \text{ cfs} \left(1 - \frac{5.73''}{19''}\right)$

$Qp_2 = 3345 \text{ cfs} \times 0.70$

$Qp_2 = 2289 \approx 2340$ cfs

6/18

7/13/78 LSW



Step 3a
Determine Surcharge Height @ "STORZ" to Pass "Qp" of 2340 cfs.

Trial #1
Assume elevation of 415.7

$Q_{\text{overflow spillway}} = CLH^{3/2}$

$$Q = 4.0(18)(0.25)^{3/2} + 4.0(\tfrac{1}{2}\,11)(2.45)^{3/2} + 4.0(\tfrac{1}{2}\,9.6)(2.45)^{3/2} + 4.0(22)(2.45)^{3/2}$$

$$= 9 + 84 + 74 + 337$$
$$= 504 \text{ cfs}$$

$Q_{\text{easterly dike}} = CLH^{3/2}$

$$Q = 2.8(\tfrac{1}{2}\,35)(1.7)^{3/2} + 2.8(\tfrac{1}{2}\,25)(1.0)^{3/2} + 2.8(\tfrac{1}{2}\,100)(1.0)^{3/2} + 2.8(25)(0.7)^{3/2} + 2.8(150)(1.2)^{3/2} + 2.8(\tfrac{1}{2}\,50)(0.5)^{3/2} + 2.8(\tfrac{1}{2}\,100)(0.3)^{3/2} + 2.8(\tfrac{1}{2}\,40)(1.5)^{3/2}$$

$$= 109 + 35 + 140 + 205 + 552 + 25 + 23 + 103$$
$$= 1192$$

$Q_{\text{westerly dike}} = CLH^{3/2}$

$$Q = 2.8(200)(0.2)^{3/2}$$
$$= 50 \text{ cfs}$$

$$Q_{TOT} = 504 + 1192 + 50$$
$$= 1746 \text{ cfs}$$

@ Elev. 415.7 $Q_{TOT} = 1746$ cfs
Contained by center dike & main dam

Anderson-Nichols & Company, Inc.

JOB NO.

Subject H/H
BAXTER LAKE

Sheet No. 8 of 18
Date 7/12/78
Computed L. Williams
Checked

Trial #2

Assume Elevation of 415.9

$Q_{\text{overflow spillway}} = CLH^{3/2}$

$$Q = 4.0(18)(0.25)^{3/2} + 4.0(\tfrac{1}{2}12)(2.65)^{3/2} + 4.0(\tfrac{1}{2}10.5)(2.65)^{3/2} + 4.0(22)(2.65)^{3/2}$$

$$= 9 + 104 + 91 + 380$$
$$= 584 \text{ cfs}$$

$Q_{\text{easterly dike}} = CLH^{3/2}$

$$Q = 2.8(\tfrac{1}{2}43)(1.9)^{3/2} + 2.8(\tfrac{1}{2}25)(1.0)^{3/2} + 2.8(125)(0.9)^{3/2} + 2.8(\tfrac{1}{2}100)(1.0)^{3/2} + 2.8(150)(1.4)^{3/2} + 2.8(\tfrac{1}{2}50)(0.5)^{3/2} + 2.8(\tfrac{1}{2}100)(0.3)^{3/2} + 2.8(\tfrac{1}{2}50)(1.7)^{3/2}$$

$$= 157 + 35 + 299 + 140 + 696 + 25 + 23 + 155$$
$$= 1530 \text{ cfs}$$

$Q_{\text{westerly dike}} = CLH^{3/2}$

$$Q = 2.8(\tfrac{1}{2}4)(0.4)^{3/2} + 2.8(\tfrac{1}{2}4)(0.4)^{3/2} + 2.8(200)(0.4)^{3/2}$$

$$= 1.4 + 1.4 + 142$$
$$= 145 \text{ cfs}$$

$$Q_{TOT} = 584 + 1530 + 145 \text{ cfs}$$
$$= 2259 \text{ cfs}$$

At elevation 415.9 (2.9' above spillway boards, 3.9' above permanent spillway concrete) is discharge is 2259 cfs. Center dike & main dam embankment contains.

Refer to Storage Elevation Curve:

@ 415.9 Surcharge Height to pass Qp2 of 2340 cfs:

Volume $= 4.6 \times 10^7$ ft^3

$4.6 \times 10^7 \cancel{ft^3} \times \frac{1}{3.98\ mi^2} \times \frac{1\ mi^2}{5280^2\ ft^2} = 0.41$ ft.

0.41 ft. $\times 12$ in/ft. $= 5.0''$ STOR 2 in inches runoff

Step 3b.

STOR 1 = 5.73" runoff
STOR 2 = 5.0" runoff

Average = 5.37" runoff or 0.45'

$0.45' \times \frac{3.98\ mi^2}{1} \times \frac{(5280)^2\ ft^2}{1\ mi^2} = 5.0 \times 10^7$ ft3

Refer to Storage Elevation Curve:

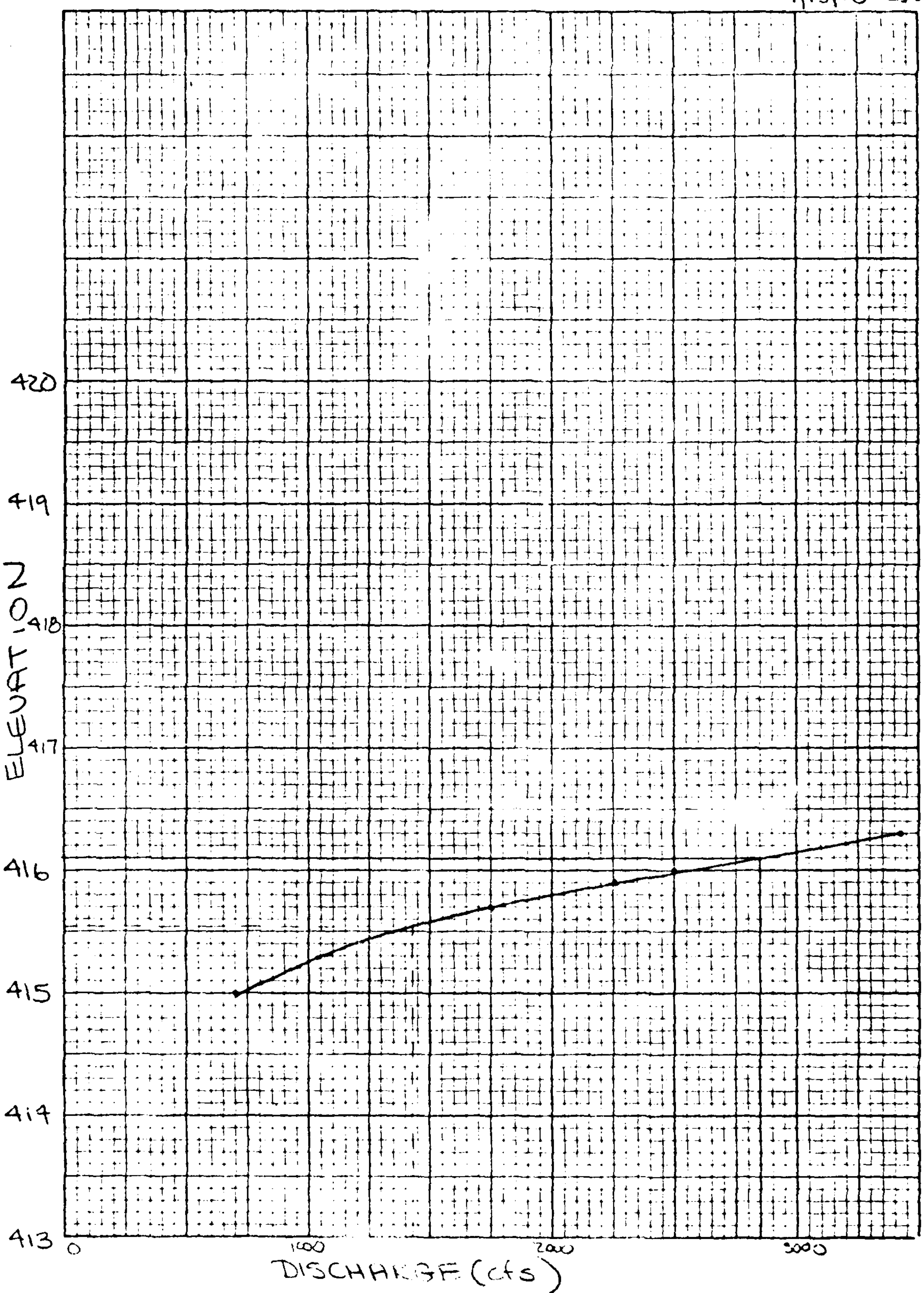
5.0×10^7 ft^3 reads ELEVATION = 416.1

Refer to Elevation vs Discharge Curve:

Elevation 416.1 = 2850 cfs

Elevation Top Boards 413.0
Elevation Spillway Concrete 412.0
Elevation low pt. easterly dike 414.0
Elevation low pt. westerly dike 415.5
Elevation low pt. center dike 417.2
Elevation top dam embankment 416.3

10/18
7/13/10 LJW



UARES · IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

CONCLUSIONS:

PMF Discharge = 2850 cfs
Elevation 416.1

PMF is contained by the Center Dike and the Main dam embankment.

PMF ELEVATION 416.1 is:

2.1' over low pt. easterly dike
3.1' over spillway boards (normal pool)
4.1' over spillway concrete pad
0.6' over low pt. westerly dike

and

1.1' below center dike low pt.
0.2' below top main dam embankment

½ PMF ≈ 1425 cfs
Elevation 415.55

½ PMF Elevation 415.55 is:

1.55' over low pt. easterly dike
2.55' over spillway boards (normal pool)
3.55' over spillway concrete pad
.05' just overtopping westerly dike

and

1.65' below low pt. center dike
0.75' below top main dam embankment

Storage normal = 1400 ac-ft @ elev. 413
Storage maximum = 1720 ac-ft @ elev. 414
Surface Areas:
at elev 413 = 316 acres
elev 414 (maximum storage) = 324 acres
elev 416.3 (top main dam embankment) = 414 acres
elev. 417.2 (low pt. center dike) = 427 acres

To determine surface areas:

use frustrum of pyramid equation

$$\text{Vol.(acre-feet)} = \frac{1}{3} h \left(B_1 + B_2 + \sqrt{B_1 B_2}\right)$$

h = elevation above normal pool
B_1 = surface area normal pool (acres)
B_2 = surface area - enlarged (acres)

All parameters are known (determined) except for B_2 — solve for B_2 using quadratic equation

$$B_2 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

① AT normal pool el. 413.0 — surface area = 316. acres

② AT pond el. 414.0

volume = 320 acre-feet $= \frac{1}{3} \cdot 1' \left(316\text{acres} + B_2 + \sqrt{316 B_2}\right)$

$$960 = \left(316 + B_2 + \sqrt{316 B_2}\right)$$

$$644 = B_2 + \sqrt{316 B_2}$$

$$644 - B_2 = \sqrt{316 B_2} \quad \text{(square both sides)}$$

$$B_2^2 - 1288 B_2 + 644^2 = 316 B_2$$

$$B_2^2 - 1604 B_2 + 644^2 = 0$$

solve for B_2 using quadratic equation
$a = 1$
$b = -1604$
$c = 644^2$

$$B_2 = \frac{1604 \pm \sqrt{(-1604)^2 - 4 \cdot 1 \cdot 644^2}}{2 \cdot 1}$$

B_2 = 324 acres @ el. 414

③ AT pond el. 416.3

volume = 1200 acre-ft = $\frac{1}{3} \cdot 3.3(316 + B_2 + \sqrt{316 B_2})$

$1091 = 316 + B_2 + \sqrt{316 B_2}$

$775 - B_2 = \sqrt{316 B_2}$

$B_2^2 - 1550 B_2 + 775^2 = 316 B_2$

$B_2^2 - 1866 B_2 + 775^2 = 0$

$B_2 = 414$ acres @ el. 416.3

④ AT pond el. 415.9

volume = 1050 acre-ft. = $\frac{1}{3} \cdot 2.9(316 + B_2 + \sqrt{316 B_2})$

$770 - B_2 = \sqrt{316 B_2}$

$B_2^2 - 1540 B_2 + 770^2 = 316 B_2$

$B_2^2 - 1856 B_2 + 770^2 = 0$

$B_2 = 410$ acres @ el 415.9

⑤ AT pond el. 417.2

volume = 1570 ac-ft = $\frac{1}{3} \cdot 4.2(316 + B_2 + \sqrt{316 B_2})$

$1121 = 316 + B_2 + \sqrt{316 B_2}$

$805 - B_2 = \sqrt{316 B_2}$

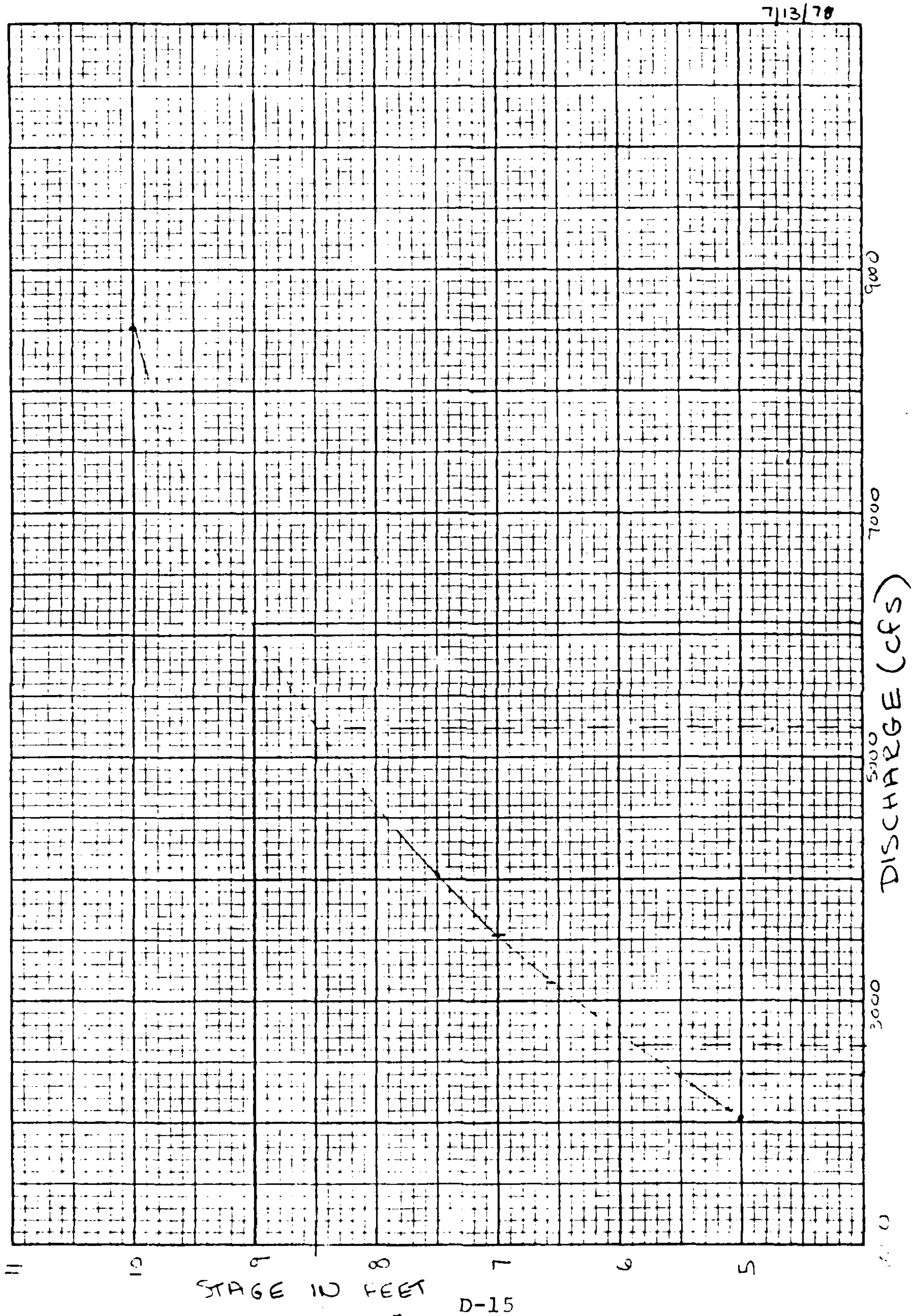
$B_2^2 - 1610 B_2 + 805^2 = 316 B_2$

$B_2^2 - 1946 B_2 + 805^2 = 0$

$B_2 = 427$ acres @ 417.2

14/18

7/13/78



D/S Hazard Analysis - using maximum pool elevation of 414 to determine breach discharge.

Storage @ time of failure - 1,720

Step 2: $Q_{P1} = \frac{8}{27} W_b \sqrt{g}\, y_o^{3/2}$

W_b = breach width

g = 32.2 ft/sec^2

y_o = pool elev. - river bed

@ Baxter Lake Easterly Dike

W_b = 100' (1/3 length @ easterly end)

g = 32.2 ft/sec^2

y_o = 414 - 408 = 6

From above equation: Q = 2471 cfs

Assume all other structures hold. Since all structures drain into same downstream reach, Q = outflow from other structures + breach Q

2471	- breach Q
166	- stoplog spillway (stoplogs removed)
0	- main dam - gate closed
0	- Westerly dike
0	- Center dike
2637	- total Q

Use the rating curve established from typical section of downstream reach (dike to Route 202A, about 1.9 miles downstream). - Page

Q of 2637 - Stage 5.9'

Reach length = 10031'

Area @ 5.9' stage = 685 ft^2 ≈ 158 AC-FT

$Q_{P2} = 2637\left(1 - \frac{158}{1720}\right)$

= 2395 cfs

Stage = 5.5'

Area @ 5.5' stage = 580 ft^2 ≈ 134 AC-FT

$Q_{p2} = 2637\left(1 - \frac{146}{1720}\right)$
$= 2413$ cfs
Stage 5.6'

@ Ten Rod Road - can handle 1000± cfs; would be overtopped

Road Data: Opening - Area = 54 ft²
Length 46'
HW Available = 2.2'
Pipe Arch - 7' rise; 10' span

ORIFICE EQUATION:

$K_f = \frac{29.1(.024)^2 46}{(2)^{4/3}}$ $= 0.31$

$n = .024$
$L = 46'$
$R = 2.0$

Entrance & exit losses ≈ 1.1
∴ Tot K = 1.4
$K = \frac{1}{C^2}$ $1.4 = \frac{1}{C^2}$ $C = 0.85$

$Q = CA\sqrt{2gh}$
Assume wsel @ top of road
$Q = 0.85(54)\sqrt{2(32.2 \times 7.2)}$
$Q = 1000 \pm$ cfs

$C = 0.85$
$A = 54$
$g = 32.2$
$h = 2.2 + 5 = 7.2$

@ 202A - can handle 3377± cfs - safely pass breach flow.

$K_f = \frac{29.1(.02)^2 32.5}{(3)^{4/3}}$
$= 0.09$

Area = 9 × 18.3 = 165 ft²
L = 32.5'
H.W. = 2.4'
$n = .02$, $R = A/P = \frac{165}{55} = 3.0$

Entrance & exit losses ≈ 1.2
∴ Tot K = 1.3; $K = \frac{1}{C^2} = 1.3 = \frac{1}{C^2} = 0.88$

Assume wsel @ top of road
$Q = CA\sqrt{2gh}$
$Q = 0.88(165)\sqrt{2(32.2 \times 8.4)}$
$Q = 3377$ cfs

$C = 0.88$
$A = 165$
$g = 32.2$
$h = 2.4 + 6 = 8.4$

D/S Hazard ANALYSIS - using maximum pool (elev. 414 based on easterly dike) to determine breach discharge.

Storage @ time of failure - 1,720

Step 2: $Q_{p1} = \frac{8}{27} W_b \sqrt{g}\, y_0^{3/2}$
W_b = breach width
$g = 32.2$ ft/sec^2
y_0 = pool elev. - river bed

@ Baxter Lake Main Dam
$W_b = 55'$
$g = 32.2$ ft/sec^2
$y_0 = 414 - 403 = 11$

From above equation: Q = 3374 cfs
Assume all other structures hold.

3374 - breach Q
166 - stoplog spillway (without stoplogs)
3540 - total breach Q

Use rating curve established from typical section of downstream reach - See page 16

Q - 3540 cfs - Stage = 7.0'
Reach length = 10031'
Area @ 7' stage = 890 ft^2 = 205 AC-FT

$Q_{p2} = 3540\left(1 - \frac{205}{1720}\right)$
$= 3118$ cfs
Stage = 6.5'
Area @ 6.5' stage = 785 ft^2 = 181 AC-FT

$Q_{p2} = 3540\left(1 - \frac{193}{1720}\right)$
$= 3143$ cfs
Stage = 6.6'

Ten Rod Road overtopped
Route 202A - verge of overtopping
For analysis of flow capacity - see page 18.

D/S Hazard Analysis - using maximum pool (elev. 414 based on easterly dike) to determine breach discharge.

Storage at time of failure - 1,720

Step 2: $Q_{p1} = \frac{8}{27} W_b \sqrt{g}\, y_o^{3/2}$

W_b = breach width

$g = 32.2$ ft/sec²

y_o = pool elev. - river bed

@ Baxter Lake Center Dike

$W_b = 80'$ (at left end)

$g = 32.2$ ft/sec²

$y_o = 414 - 407.7 = 6.3$

From above equation: Q = 2127

Total Q:

2127 - Center dike breach
166 - stoplog spillway
2293

Use rating curve established from typical section of downstream reach. - See page 16.

Q - 2293 cfs : Stage - 5.4'

Reach length - 1003'

Area @ 5.4' stage - 560 ft² = 129 AC-FT

$Q_{p2} = 2293\left(1 - \frac{129}{1720}\right)$
$= 2121$ cfs

Stage = 5.1' stage - 510 ft² = 117 AC-FT

$Q_{p2} = 2293\left(1 - \frac{123}{1720}\right)$
$= 2129$ cfs

Stage = 5.1'

Ten Rod Road overtopped

Route 202A - can handle flow

For analysis of flow capacity see page 18.

APPENDIX E

INFORMATION AS
CONTAINED IN THE NATIONAL
INVENTORY OF DAMS

END

FILMED

8-85

DTIC